

applies to many vertebrate brains, including human brains. When it comes to detecting and responding to danger, the brain just hasn't changed much. In some ways we are emotional lizards. I am quite confident in telling you that studies of fear reactions in rats tell us a great deal about how fear mechanisms work in our brains as well.

## *From Emotions Revealed: Recognizing Faces and Feelings to Improve Communication and Emotional Life*

*Paul Ekman*

I began the project believing that expression and gesture were socially learned and culturally variable, and so did the initial group of people I asked for advice—Margaret Mead, Gregory Bateson, Edward Hall, Ray Birdwhistell, and Charles Osgood. I recalled that Charles Darwin had made the opposite claim, but I was so convinced that he was wrong that I didn't bother to read his book.

The second stroke of luck was meeting Silvan Tomkins. He had just written two books about emotion in which he claimed that facial expressions were innate and universal to our species, but he had no evidence to back up his claims. I don't think I would ever have read his books or met him if we hadn't both submitted articles on nonverbal behavior to the same journal at the same time—Silvan's a study of the face, mine a study of body movement.

I was very impressed with the depth and breadth of Silvan's thinking, but I thought he was probably wrong in his belief, like Darwin's, that expressions were innate and therefore universal. I was delighted that there were two sides to the argument, that it wasn't just Darwin, who had written a hundred years earlier, who opposed Mead, Bateson, Birdwhistell, and Hall. It wasn't a dead issue. There was a real argument between famous scientists, elder statesmen; and I, at the age of thirty, had the chance, and the funding, to try to settle it once and for all: Are expressions universal, or are they, like language, specific to each culture? Irresistible! I really didn't care who proved to be correct, although I didn't think it would be Silvan.

In my first study I showed photographs to people in five cultures—Chile, Argentina, Brazil, Japan, and the United States—and asked them to judge what emotion was shown in each facial expression. The majority in

every culture agreed, suggesting that expressions might really be universal. Carrol Izard, another psychologist who had been advised by Silvan, and was working in other cultures, did nearly the same experiment and got the same results. Tomkins had not told either of us about the other, something that we initially resented when we found out we were not doing this work alone, but it was better for science that two independent researchers found the same thing. It seemed that Darwin was right.

There was a problem: How could we have found that people from many different cultures agreed about what emotion was shown in an expression when so many smart people thought just the opposite? It wasn't just the travelers who claimed that the expressions of the Japanese or the Chinese or some other cultural group had very different meanings. Birdwhistell, a respected anthropologist who specialized in the study of expression and gesture (a protégé of Margaret Mead), had written that he abandoned Darwin's ideas when he found that in many cultures people smiled when they were unhappy. Birdwhistell's claim fit the view that dominated cultural anthropology and most of psychology—anything socially important, such as emotional expressions, must be the product of learning, and therefore different in each culture.

I reconciled our findings that expressions are universal with Birdwhistell's observation of how they differ from one culture to another by coming up with the idea of *display rules*. These, I proposed, are socially learned, often culturally different, rules about the management of expression, about who can show which emotion to whom and when they can do so. It is why in most public sporting contests the loser doesn't show the sadness and disappointment he or she feels. Display rules are embodied in the parent's admonition—"Get that smirk off your face." These rules may dictate that we diminish, exaggerate, hide completely, or mask the expression of emotion we are feeling.

I tested this formulation in a series of studies that showed that when alone Japanese and Americans displayed the same facial expressions in response to seeing films of surgery and accidents, but when a scientist sat with them as they watched the films, the Japanese more than the Americans masked negative expressions with a smile. In private, innate expressions; in public, managed expressions. Since it is the public behavior that anthropologists and most travelers observe, I had my explanation and evidence of its operation. In contrast, symbolic gestures—such as the head nod yes, the head shake no, and the A-OK gesture—are indeed culture-specific. Here

Birdwhistell, Mead, and most other behavioral scientists were right, though they were wrong about the facial expressions of emotion.

There was a loophole, and if I could see it, so might Birdwhistell and Mead, who I knew would search for any way to dismiss my findings. All the people I (and Izard) had studied might have learned the meaning of Western facial expressions by watching Charlie Chaplin and John Wayne on the movie screen and television tube. Learning from the media or having contact with people from other cultures could explain why people from different cultures had agreed about the emotions shown in my photographs of Caucasians. I needed a visually isolated culture where the people had seen no movies, no television, no magazines, and few, if any, outsiders. If they thought the same emotions were shown in my set of facial expression photographs as the people in Chile, Argentina, Brazil, Japan, and the United States, I would have it nailed.

My entry to a Stone Age culture was Carleton Gajdusek, a neurologist who had been working for more than a decade in such isolated places in the highlands of Papua New Guinea. He was trying to find the cause of a strange disease, kuru, which was killing about half the people in one of these cultures. The people believed it was due to sorcery. When I arrived on the scene, Gajdusek already knew that it was due to a slow virus, a virus that incubates for many years before any symptoms become apparent (AIDS is such a virus). He didn't yet know how it was transmitted. (It turned out to be cannibalism. These people didn't eat their enemies, who would be more likely to be in good health if they died in combat. They are only their friends who died of some kind of disease, many of them from kuru. They didn't cook them before eating, so diseases were readily passed on. Gajdusek some years later won the Nobel Prize for the discovery of slow viruses.)

Fortunately, Gajdusek had realized that Stone Age cultures would soon disappear, so he took more than one hundred thousand feet of motion picture films of the daily lives of the people in each of two cultures. He had never looked at the films; it would have taken nearly six weeks to look just once at his films of these people. That's when I came along.

Delighted that someone had a scientific reason for wanting to examine his films, he lent me copies, and my colleague Wally Friesen and I spent six months carefully examining them. The films contained two very convincing proofs of the universality of facial expressions of emotion. First, we never saw an unfamiliar expression. If facial expressions are completely

learned, then these isolated people should have shown novel expressions, ones we had never seen before. There were none.

It was still possible that these familiar expressions might be signals of very different emotions. But while the films didn't always reveal what happened before or after an expression, when they did, they confirmed our interpretations. If expressions signal different emotions in each culture, then total outsiders, with no familiarity with the culture, should not have been able to interpret the expressions correctly.

I tried to think how Birdwhistell and Mead would dispute this claim. I imagined they would say, "It doesn't matter that there aren't any new expressions; the ones you did see really had different meanings. You got them right because you were tipped off by the social context in which they occurred. You never saw an expression removed from what was happening before, afterward, or at the same time. If you had, you wouldn't have known what the expressions meant." To close this loophole, we brought Silvan from the East Coast to spend a week at my lab.

Before he came we edited the films so he would see only the expression itself, removed from its social context, just close-up shots of a face. Silvan had no trouble at all. Every one of his interpretations fit the social context he hadn't seen. What's more, he knew exactly how he got the information. Wally and I could sense what emotional message was conveyed by each expression, but our judgments were intuitively based; we usually could not specify exactly what in the face carried the message unless it was a smile. Silvan walked up to the movie screen and pointed out exactly which specific muscular movements signaled the emotion.

We also asked him for his overall impression of these two cultures. One group he said seemed quite friendly. The other was explosive in their anger, highly suspicious if not paranoid in character, and homosexual. It was the Anga that he was describing. His account fit what we had been told by Gajdusek, who had worked with them. They had repeatedly attacked Australian officials who tried to maintain a government station there. They were known by their neighbors for their fierce suspiciousness. And the men led homosexual lives until the time of marriage. A few years later the ethnologist Irenäus Eibl-Eibesfeldt literally had to run for his life when he attempted to work with them.

After that meeting I decided to devote myself to the study of facial expression. I would go to New Guinea and try to get evidence to support what

I then knew to be true—that at least some facial expressions of emotion are universal. And I would work to develop an objective way to measure facial behavior so that any scientist could objectively derive from facial movement what Silvan could see so keenly.

Late in 1967 I went to the South East Highlands to do research on the Fore people, who lived in small scattered villages at an elevation of seven thousand feet. I did not know the Fore language, but with the help of a few boys who had learned Pidgin from a missionary school, I could go from English to Pidgin to Fore and back again. I brought with me pictures of facial expressions, mostly the pictures I had been given by Silvan for my studies of literate cultures. (Following, on page 251, are three examples.) I also brought photographs of some Fore people I had selected from the motion picture film, thinking they might have trouble interpreting the expressions shown by Caucasians. I even worried that they might not be able to understand photographs at all, never having seen any before. Some anthropologists had earlier claimed that people who hadn't seen photographs had to learn how to interpret them. The Fore had no such problem, though; they immediately understood the photographs, and it didn't seem to make much of a difference what nationality the person was, Fore or American. The problem was what I asked them to do.

They had no written language, so I couldn't ask them to pick a word from a list that fit the emotion shown. If I were to read them a list of emotion words, I would have to worry about whether they remembered the list, and whether the order in which the words were read influenced their choice. Instead I asked them to make up a story about each facial expression. "Tell me what is happening now, what happened before to make this person show this expression, and what is going to happen next." It was like pulling teeth. I am not certain whether it was the translation process, or the fact that they had no idea what it was I wanted to hear or why I wanted them to do this. Perhaps making up stories about strangers was just something the Fore didn't do.

I did get my stories, but it took each person a lot of time to give me each story. They and I were exhausted after each session. Nevertheless, I had no shortage of volunteers, even though I suspect the word was out that what I was asking wasn't easy to do. There was a powerful incentive to look at my photographs: I gave each person either a bar of soap or a pack of cigarettes for helping me. They had no soap, so it was highly valued. They grew

their own tobacco, which they smoked in pipes, but they seemed to like my cigarettes better.

Most of their stories fit the emotion each photograph supposedly depicted. For example, when looking at a picture depicting what people in literate cultures judged as sadness, the New Guineans most often said that the person's child had died. But the storytelling procedure was awkward, and proving that the different stories fit a particular emotion would not be an easy task. I knew I had to do it differently, but I didn't know how.

I also filmed spontaneous expressions and was able to catch the look of joy when people from another nearby village met their friends. I arranged situations to provoke emotions. I recorded two men playing their musical instruments, and then I filmed their surprise and delight when for the first time they heard their voices and music come out of a tape recorder. I even stabbed a boy with a rubber knife I had brought with me, as my movie camera recorded his response and the reactions of his friends. They thought it was a good joke. (I had the good sense not to try this trick with one of the men.) Such film clips could not serve as my evidence, for those committed to the view that expressions differ in each culture could always argue I had selected only those few occasions when universal expressions were shown.

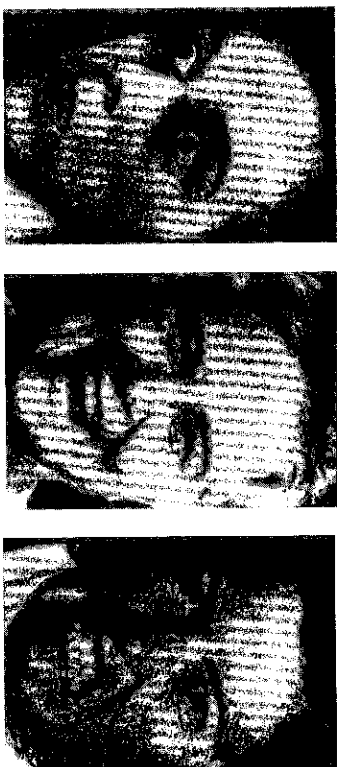
I left New Guinea after a few months—not a hard decision because I was hungry for conversation, something I couldn't have with any of these people, and for food, since I had made the mistake of thinking I would enjoy eating the local cuisine. Yams and something resembling the part of the asparagus we discard grew pretty tiresome. It was an adventure, the most exciting one of my life, but I was still worried that I had not been able to get definitive evidence. I knew this culture would not stay isolated much longer, and there were not many others like it still left in the world.

Back home I came across a technique that psychologist John Dashiell had used in the 1930s to study how well young children could interpret facial expressions. They were too young to read, so he couldn't give them a list of words from which to choose. Instead of asking them to make up a story—as I had done in New Guinea—Dashiell cleverly read them a story and showed them a set of pictures. All they had to do was pick the one that fit the story. I knew that would work for me. I went over the stories the New Guineans had made up, picking the story that had been given most often for each type of emotional expression. They were pretty simple: "His/her friends have come and s/he is happy; s/he is angry and about to fight; his/her child

has died and s/he feels very sad; s/he is looking at something s/he dislikes, or s/he is looking at something that smells bad; he/she is just now looking at something new and unexpected."

There was a problem with the most frequent story for fear, about the danger posed by a wild pig. I had to change it to reduce the chance that it would be relevant to surprise or anger. It went like this: "S/he is sitting in her/his house all alone, and there is no one else in the village. There is no knife, axe, or bow and arrow in the house. A wild pig is standing in the door of the house, and the man (woman) is looking at the pig and is very afraid of it. The pig has been standing in the doorway for a few minutes and the person is looking at it very afraid, and the pig won't move away from the door and s/he is afraid the pig will bite him/her."

I made up sets of three pictures, which would be shown while one of the stories was read (an example appears below). The subject would only have to point to the picture. I made up many sets of pictures. I didn't want any picture to appear more than once, so the person's choice wouldn't be made by exclusion: "Oh, that was the one where the child died, and that was the one where I said she was about to fight, so this one must be the one about the pig."



I returned to New Guinea late in 1968 with my stories and pictures and a team of colleagues to help gather the data. (This time I also brought canned food.) Our return was heralded, I suppose, because apart from Gajdusek and his filmmaker, Richard Sorenson (who was of great help to me in the prior year), very few outsiders ever visited, and even fewer returned. We did travel to some villages, but once the word got out that what we were

asking was very easy to do, people from villages far away started coming to us. They liked the task and were again delighted with the soap and cigarettes.

I took special care to ensure that no one in our group would unwittingly tip off the subjects as to which picture was the correct one. The sets of pictures were mounted onto transparent pages, with a code number written on the back of each picture that could be seen from the backside of the page. We did not know, and made a point of not finding out, which codes went with each expression. Instead a page would be turned toward the subject, arranged so that the person writing down the answers would not be able to see the front of the page. The story would be read, the subject would point to the picture, and one of us would write down the code number for the picture the subject had chosen.

In the space of just a few weeks we saw more than three hundred people, about 3 percent of this culture, and more than enough to analyze statistically. The results were very clear-cut for happiness, anger, disgust, and sadness. Fear and surprise were not distinguished from each other—when people heard the fear story, they just as often picked a surprise as a fear expression, and the same was true when they heard the surprise story. But fear and surprise were distinguished from anger, disgust, sadness, and happiness. To this day I do not know why fear and surprise were not distinguished from each other. It could have been a problem with the stories, or it could have been that these two emotions are so often intermingled in these people's lives that they aren't distinguished. In literate cultures fear and surprise are distinguished from each other.

All except twenty-three of our subjects had seen no movies, television, or photographs; they neither spoke nor understood English or Pidgin, had not lived in any Western settlement or government town, and had never worked for a Caucasian. The twenty-three exceptions had all seen movies, spoke English, and had attended a missionary school for more than a year. There were no differences between the majority of the subjects who had little contact with the outside world and the few who had, nor were there any differences between males and females.

We did one more experiment, which was not as easy for our subjects. One of the Pidgin speakers read them one of the stories and asked them to show what their face would look like if they were the person in the story. I videotaped nine men doing this; none of whom had participated in the first study. The unedited videotapes were shown to college students in America.

If the expressions were culture-specific, then these college students would not be able to interpret correctly the expressions. But the Americans correctly identified the emotion except for the fear and surprise poses, where they were equally likely to call the pose fear or surprise, just like the New Guineans. Here are four examples of the New Guineans' poses of emotion.



ENJOYMENT



SADNESS



ANGER



DISGUST

I announced our findings at the annual anthropology national conference in 1969. Many were unhappy with what we had found. They were firmly convinced that human behavior is all nurture and no nature; expressions must be different in each culture, despite my evidence. The fact that I had actually found cultural differences in the *management* of facial expressions in my Japanese American study was not good enough.

The best way to dispel their doubts would be to repeat the entire study in another preliterate, isolated culture. Ideally, someone else should do it, preferably someone who wanted to prove me wrong. If such a person found what I found, that would enormously strengthen our case. Because of another stroke of luck, the anthropologist Karl Heider did just that.

Heider had recently come back from spending a few years studying the Dani, another isolated group in what is now called West Irian, part of Indonesia. Heider told me there must be something wrong with my research because the Dani didn't even have words for emotions. I offered to give him all of my research materials and teach him how to run the experiment the next time he went back to the Dani. His results perfectly replicated my findings, even down to the failure to distinguish between fear and surprise.

Nevertheless, not all anthropologists are convinced, even today. And there are a few psychologists, primarily those concerned with language, who complain that our work in literate cultures, where we asked people to identify the emotion word that fit the expressions, does not support universals since the words for each emotion don't have perfect translations. How emotions are represented in language is, of course, the product of culture rather than evolution. But in studies of now more than twenty literate Western and Eastern cultures, the judgment made by the majority in each culture about what emotion is shown in an expression is the same. Despite the translation problems, there has never been an instance in which the majority in two cultures ascribes a different emotion to the same expression.

## From Woman: An Intimate Biography

Natalie Angier

A female rat can't mate if she is not in estrus. I don't mean that she doesn't want to mate, or that she won't find a partner if she's not in heat and sending forth the appropriate spectrum of olfactory and auditory enticements. I mean that she is physically incapable of copulating. Unless she is in estrus, her ovaries do not secrete estrogen and progesterone, and without hormonal stimulation, the rat can't assume the mating position known as lordosis, in which she arches her back and flicks aside her tail. The lordosis posture changes the angle and aperture of the vagina, making it accessible to the male rat's penis once he has mounted her from behind. There is no rat's version of the *Kama Sutra*. An ovariectomized female won't assume lordosis, and hence she can't mate—unless, that is, she is given hormone shots to compensate for the loss of the natural ablations of the ovarian follicle.

In a female guinea pig, a membrane normally covers the vaginal opening. It takes the release of sex hormones during ovulation to open up the membrane and allow the guinea pig to have sex.

For both the rat and the guinea pig, as well as for many other female animals, mechanics and motivation are intertwined. Only when she is in heat is the female driven to seek a mate, and only when she is in heat can her body oblige her. Estrogen controls her sexual appetite and sexual physics alike.

A female primate can copulate whenever she pleases, whether she is ovulating or not. There is no connection between the mechanics of her reproductive tract and the status of her hormones. Estrogen does not control the nerves and muscles that would impel her to hoist her rear end in the air, angle her genitals just so, and whip her tail out of the way, if she has one. A female primate does not have to be capable of becoming pregnant in order to partake of sex. She can have sex every day, and if she's a bonobo, she will have sex more than once a day, or once an hour. A female primate has been